

TERATOSPHAERIA PROTEAE-ARBOREAE AND MYCOSPHAERELLA JONKERSHOEKENSIS, TWO NEW ASCOMYCETES ON PROTEA IN SOUTH AFRICA

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ABSTRACT

Two new species of Ascomycetes on *Protea spp.* in the Cape Province are described and compared with related fungi on South African Proteaceae. *Teratosphaeria proteae-arborescens* Van Wyk, Marasas & Knox-Davies sp. nov., on *P. arborea* Houttuyn is characterized by ascostromata that are irregularly crowded together in the centre of circular, raised leaf spots and ascospores $18-32 \times 5-9 \mu\text{m}$ in size. It differs in these respects from *T. fibrillosa* Syd. which produces ascocarps in centrifugal, branched, radiating lines, and has considerably larger ascospores. *Mycosphaerella jonkershoekensis* Van Wyk, Marasas & Knox-Davies sp. nov., on *P. repens* L. and *P. barbigera* Meisn. differs from *M. proteae* (Syd.) Von Arx in the production of circular, necrotic leaf spots, smaller asci, and smaller, somewhat differently-shaped ascospores.

UITTREKSEL

TERATOSPHAERIA PROTEAE-ARBOREAE EN MYCOSPHAERELLA JONKERSHOEKENSIS, TWEE NUWE ASKOMISETE OP PROTEA IN SUID-AFRIKA

Twée nuwe spesies van Askomisete op *Protea spp.* in die Kaapprovinsie word beskryf en vergelyk met verwante fungi op Suid-Afrikaanse Proteaceae. *Teratosphaeria proteae-arborescens* Van Wyk, Marasas & Knox-Davies sp. nov., op *P. arborea* Houttuyn word gekenmerk deur askostromata wat onreëlmatig opeengedruk in die middel van ronde, verheve blaarvlekke voorkom en askospore $18-32 \times 5-9 \mu\text{m}$ in grootte. Dit verskil in hierdie opsigte van *T. fibrillosa* Syd. wat askokarpe in sentrifugale, vertakte, uitstralende lyne vorm en wat aansienlik groter askospore het. *Mycosphaerella jonkershoekensis* Van Wyk, Marasas & Knox-Davies sp. nov., op *P. repens* L. en *P. barbigera* Meisn. verskil van *M. proteae* (Syd.) Von Arx in die veroorsaking van ronde, gesonke, nekrotiese blaarvlekke en die vorming van kleiner askusse en kleiner askospore wat ook effens in vorm verskil.

In the course of an investigation of the foliicolous fungi of South African Proteaceae (Van Wyk, 1973), two interesting Ascomycetes were collected on *Protea spp.* in the Cape Province. Both of these fungi belong to genera (*Teratosphaeria* and *Mycosphaerella*) which are each represented by a single known species on the genus *Protea* in South Africa. The present collections differ from the existing species in several respects and are consequently described here as new species. The type specimens are deposited in the Mycological Herbarium of the Plant Protection Research Institute, Private Bag X134, Pretoria, Republic of South Africa (PREM).

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Teratosphaeria proteae-arboreae Van Wyk, Marasas et Knox-Davies sp. nov.

Maculae amphigenae, orbiculatae, 1–3 mm diam., elevatae, atrae, marginibus puniceis. *Acostromata* in contextu matricis immersa, unilocularia, fusca vel atra, pyriformia, globosa vel depresso-globosa, $120\text{--}194 \times 113\text{--}234\text{ }\mu\text{m}$, pariete plectenchymato $10\text{--}20\text{ }\mu\text{m}$ diam., poro per stoma erumpente. *Asci* sessiles, obclavati vel lageniformes, bitunicati, apice crassius tunicati, octospori, $70\text{--}96 \times 18\text{--}35\text{ }\mu\text{m}$, paraphysibus deliquescentibus. *Ascospores* oblique monostichae vel distichae, cylindratae utrinque rotundatae, rectae, medio uniseptatae, leniter constrictae, contentu subtiliter granulato, primum hyalinae, deinde brunae $18\text{--}32 \times 5\text{--}9\text{ }\mu\text{m}$. *Spermogonia* intermixta cum ascostromatibus, spermatiis hyalinis, continuis bacillaribus, $1,6\text{--}3,1 \times 1,0\text{ }\mu\text{m}$.

Hab. in foliis vivis *Protea arborea* Houttuyn, Jonkershoek, Stellenbosch, Cape Province, Republic of South Africa, 21.6.1971, leg. Van Wyk (PREM 44801, holotypus).

Leaf Spots amphigenous, circular, 1–3 mm diam., raised and black in the centre due to the development of ascocarps, surrounded by a narrow pinkish margin which may enlarge to form a necrotic zone (Figs. 1,2). *Acostromata* crowded, dark-brown to black, unilocular, pyriform or ellipsoidal to subglobose and flattened above and on the sides, $120\text{--}194\text{ }\mu\text{m}$ high and $113\text{--}234\text{ }\mu\text{m}$ wide, immersed in the leaf tissue below the epidermis with the apex penetrating the stomata and opening by means of a porus (Fig. 4). Locular wall $10\text{--}20\text{ }\mu\text{m}$ wide, composed of several layers of dark-brown plectenchymatous cells. No superficial mycelium present, but strands of brown, septate, vegetative hyphae extend from the ascostromata into the intercellular spaces of the mesophyll. *Asci* basal, surrounded by delicate paraphysoids that gelatinise at a very early stage, sessile, obclavate or lageniform, bitunicate with the wall markedly thickened towards the apex, eight-spored, $70\text{--}96 \times 18\text{--}35\text{ }\mu\text{m}$. *Ascospores* obliquely monostichous or distichous, cylindrical with both ends rounded, straight, one-septate in the middle, slightly constricted at the septum, surface finely granular, at first hyaline, becoming light-brown at maturity, $18\text{--}32 \times 5\text{--}9\text{ }\mu\text{m}$ (Fig. 5). *Spermogonia* occur intermingled with the ascocarps and have the same general structure but contain a hymenium of spermatophores and minute, one-celled, hyaline, bacillar spermatia, $1,6\text{--}3,1 \times 1,0\text{ }\mu\text{m}$.

On living leaves of *Protea arborea* Houttuyn, Jonkershoek, Stellenbosch, Cape Province, 21.6.1971, Van Wyk (PREM 44801, holotype); 1.11.1972, Van Wyk (PREM 44921, paratype).

The genus *Teratosphaeria* was established by Sydow and Sydow (1912) for a single species, *T. fibrillosa* Syd., on *Protea arborea* (= *P. grandiflora* Thunb.) from Bains Kloof, Cape Province (PREM 1217). This species was characterised by the arrangement of the ascocarps in "centrifugal, irregularly branched, radiating lines" (Doidge, 1922). The new species described here differs from the

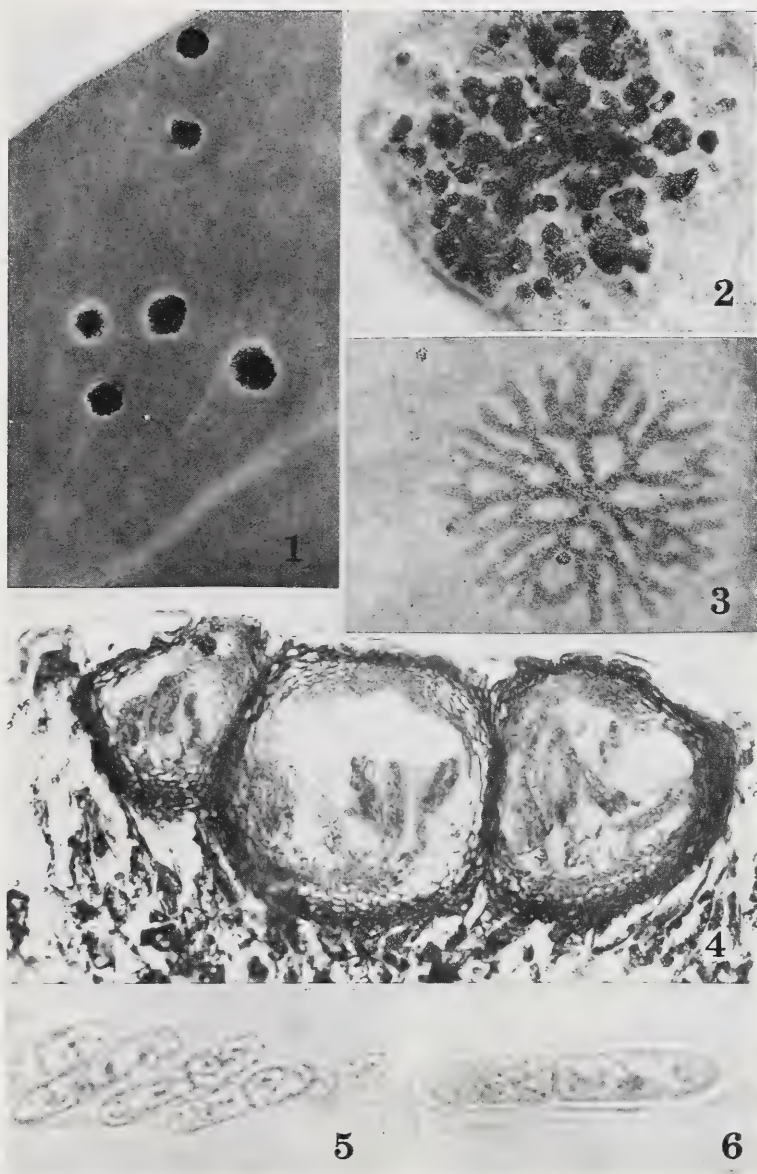


FIG. 1-6.

Teratosphaeria proteae-arboreae (PREM 44801, type) and *T. fibrillosa* (PREM 41812) on *Protea arborea*. 1. *T. proteae-arboreae*, circular, raised leaf spots, $\times 4$. 2. *T. proteae-arboreae*, black ascostromata irregularly crowded together in the centre of raised leaf spots, $\times 50$. 3. *T. fibrillosa*, ascostromata arranged in branched, radiating lines, $\times 4$. 4. *T. proteae-arboreae*, section through ascostromata immersed in the mesophyll, $\times 250$. 5. *T. proteae-arboreae*, ascospores, $\times 1000$. 6. *T. fibrillosa*, ascospore, $\times 1000$.

type collection of *T. fibrillosa* (PREM 1217) in that the ascostromata are not arranged in this characteristic pattern (Fig. 3) but are irregularly crowded together in the centre of circular, raised leaf spots (Figs. 1, 2). The ascospores of the new species are also considerably smaller ($18\text{--}32 \times 5\text{--}9\text{ }\mu\text{m}$, Fig. 5) than those of *T. fibrillosa* ($35\text{--}52 \times 8\text{--}12\text{ }\mu\text{m}$, Fig. 6) as reported by Sydow and Sydow (1912), Theissen and Sydow (1915), Doidge (1922) and Müller and Von Arx (1962).

The differences between the two species in the appearance of the leaf spots and the arrangement of the ascocarps are not due to a host effect because *T. fibrillosa* (PREM 1217, PREM 41812) as well as the new species (PREM 44801, PREM 44921) were compared on the same host, *P. arborea* (Figs. 2, 3). The new species has incidentally been found on *P. arborea* only, while *T. fibrillosa* is known to occur on *P. arborea* (= *P. grandiflora*) as well as *P. abyssinica* Willd and *P. caffra* Meisn. (Sydow and Sydow, 1912; Doidge 1922, 1950; Müller and Von Arx, 1962). The difference in ascospore size can also not be attributed to a difference in the stage of maturity of the spores. Our ascospore measurements of *T. proteae-arboreae* were based on brown, mature ascospores and these were compared with measurements of brown, mature ascospores of *T. fibrillosa* on *P. arborea* (PREM 41812) which we found to be $37,5\text{--}50,0 \times 7,5\text{--}10,0\text{ }\mu\text{m}$ (Figs. 5, 6).

Mycosphaerella jonkershoekensis Van Wyk, Marasas et Knox-Davies sp. nov.

Maculae amphigenae, orbiculatae, infossae, griseae vel brunae, marginibus elevatis fuscis, usque ad 5 mm diam. *Ascostromata* amphigena, solitaria, unilocularia, atra, pyriformia vel subglobosa, in contextu matricis immersa, $90\text{--}122 \times 88\text{--}136\text{ }\mu\text{m}$, pariete plectenchymato $8,2\text{--}29,8\text{ }\mu\text{m}$ diam. poro papilliformi per stoma erumpente. *Asci* paraphysati, sessiles vel breviter stipitati, pyriformes vel obclavati, bitunicati, apice rotundati et apice crassius tunicati, octospori, $32,0\text{--}57,2 \times 10,2\text{--}15,9\text{ }\mu\text{m}$. *Ascosporae* oblique monostichae, distichae vel tristichae, hyalinae vel subhyalinae, ellipsoideae utrinque rotundatae, uniseptatae, non constrictae, $11,2\text{--}20,7 \times 3,9\text{--}7,6\text{ }\mu\text{m}$, loculo superiore rotundato, $6,9\text{--}9,9 \times 2,0\text{--}4,9\text{ }\mu\text{m}$, loculo inferiore aequilongo vel parce longiore, $7,3\text{--}9,9 \times 2,0\text{--}4,6\text{ }\mu\text{m}$.

Hab. in foliis vivis *Protea repens* L., Jonkershoek, Stellenbosch, Cape Province, Republic of South Africa, 9.9.1971, leg. Van Wyk (PREM 44830, holotypus).

Leaf spots amphigenous, circular, sunken, necrotic, parchment-like, greyish to light-brown with a raised, dark-brown margin, visible on both sides of the leaf, up to 5 mm diam., discrete and regular in outline, except when becoming confluent to form larger lesions (Figs. 7, 8). *Ascostromata* amphigenous, unilocular, solitary, black, pyriform or subglobose, subepidermal and immersed

in the mesophyll below the stomata, apex penetrating the stomata and opening by means of a papilla-like, protruding porus, 90–122 μm high, 88–136 μm wide, locular wall 8.2–29.8 μm diam. and composed of several layers of dark-brown, plectenchymatous cells (Fig. 12). *Asci* aparaphysate, sessile or very briefly stipitate, obclavate or pyriform, bitunicate with the wall markedly thickened at the rounded apex, eight-spored, 32.0–57.2 $\times$ 10.2–15.9 μm . *Ascospores* obliquely monostichous, distichous or tristichous, hyaline or subhyaline, ellipsoidal and tapering towards the rounded ends, one-septate, not constricted, 11.2–20.7 $\times$ 3.9–7.6 μm ; upper cell broadly rounded at the apex 6.9–9.9 $\times$ 2.0–4.9 μm ; lower cell equal in length or slightly longer than the upper cell and narrowing slightly towards the rounded base, 7.3–9.9 $\times$ 2.0–4.6 μm (Fig. 10).

On living leaves of *Protea repens* L., Jonkershoek, Stellenbosch, Cape Province, 9.9.1971, Van Wyk (PREM 44830, holotype); *Protea barbiger*a Meisn., Assegaaibos, Stellenbosch, 1.11.1972, Van Wyk (PREM 44924, paratype).

M. jonkershoekensis is related to *M. proteae* (Syd.) Von Arx, which is widespread on a number of *Protea* spp. in South Africa (Doidge, 1921, 1950; Müller & Von Arx, 1962). *M. proteae* was first described as *Didymella maculiformis* Winter on *P. arborea* Houttuyn (= *P. grandiflora* Thunb.) from the Cape Province (PREM 3396) by Winter (1884). Material on *P. flanaganii* Phillips (PREM 5163) was later described as *Oligostroma proteae* by Sydow & Sydow (1914). The type collections of *D. maculiformis* and *O. proteae* were examined by Von Höhnelt (1917), who found them to be identical. The same conclusion was reached by Doidge (1921), who made the new combination *Oligostroma maculiformis* (Winter) Doidge. This species was finally transferred to the genus *Mycosphaerella* as *M. proteae* (Syd.) Von Arx by Müller & Von Arx (1962).

We examined the following collections of *M. proteae* in the Mycological Herbarium, Pretoria (PREM): *Protea arborea* Houttuyn (= *P. grandiflora* Thunb.), 3396 (type of *Didymella maculiformis* Winter); *P. amplexicaulis* R. Br., 44822; *P. barbiger*a Meisn., 44820, 44925, *P. compacta* R. Br., 44825; *P. cordata* Thunb., 44818; *P. cynaroides* L., 44819; *P. eximia* (Salisb. ex Knight) Fourcade, 44823; *P. flanaganii* Phillips, 5163 (type of *Oligostroma proteae* Syd.); *P. grandiceps* Trattinick, 44828; *P. laurifolia* Salisb. ex Knight, 44821; *P. neriifolia* R. Br., 44815, 44816; *P. obtusifolia* Buek. ex Meisn., 44827; *P. pulchra* Rycroft, 44817; *P. punctata* Meisn., 44826; *P. speciosa* L., 44824; *P. stokoei* Phillips, 44829.

The leaf spots caused by *M. proteae* on the different hosts listed above are quite variable in appearance, but typically they are amphigenous, reddish-brown to grey or black, roughened, irregular in outline, but clearly delimited by a reddish-brown margin, usually not necrotic, raised and frequently becoming dome-shaped with a corresponding concave retraction of the abaxial leaf

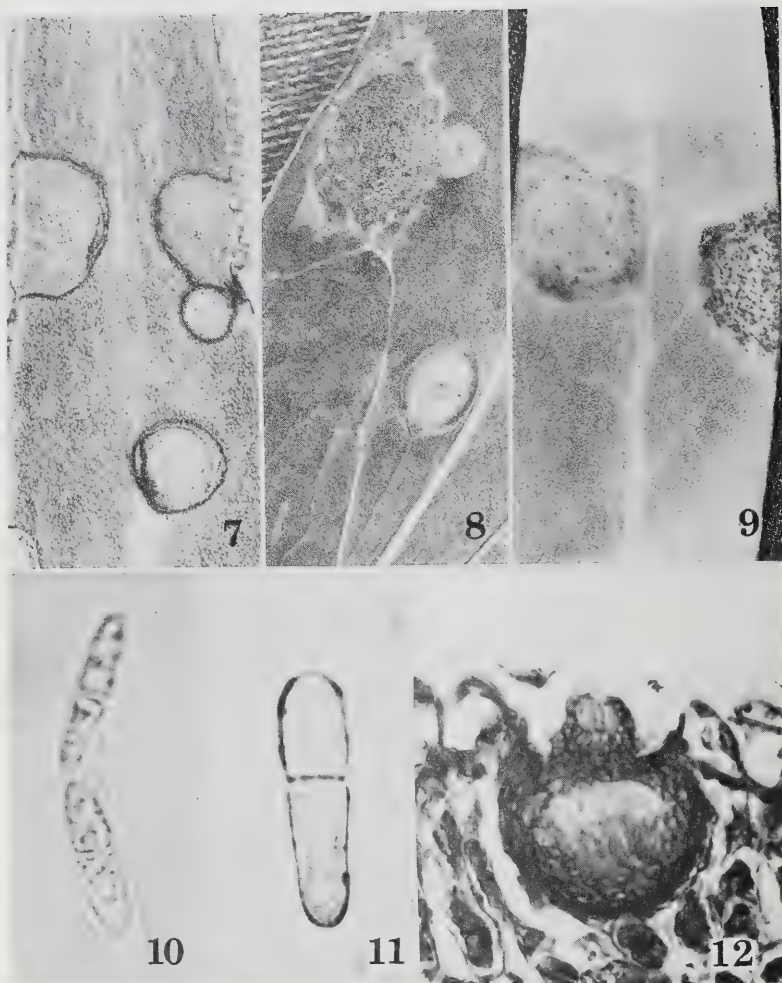


FIG. 7-12.

Mycosphaerella jonkershoekensis and *M. proteae*. 7. *M. jonkershoekensis* on *Protea repens* (PREM 44830, type), circular, sunken, necrotic leaf spots with raised margins, $\times 4$. 8. *M. jonkershoekensis* (PREM 44924) and *M. proteae* (PREM 44925) on *P. barbiger*, $\times 2.5$. The large, irregular, raised leaf spot is caused by *M. proteae* and the small, circular, discrete leaf spots are typical of *M. jonkershoekensis*. 9. *M. proteae* on *P. neriifolia* (PREM 44816), irregular, roughened, raised leaf spots, $\times 4$. 10. *M. jonkershoekensis* on *P. repens* (PREM 44830), ascospores, $\times 1\,500$. 11. *M. proteae* on *P. neriifolia* (PREM 44816), ascospore, $\times 1\,500$. 12. *M. jonkershoekensis* on *P. repens* (PREM 44830), section through ascostroma immersed in the mesophyll, $\times 390$.

surface, up to 10 mm diam. or larger by confluence (Figs. 8, 9). These leaf spots are quite distinct from the typical circular, sunken, necrotic lesions caused by *M. jonkershoekensis*. The differences in the leaf spots caused by the two species are most clearly seen in the collection on *P. barbiger* in which *M. jonkershoekensis* (PREM 49924) as well as *M. proteae* (PREM 44925) occur on the same leaves (Fig. 8). It is interesting to note that the type specimen of *M. jonkershoekensis* (PREM 44830) was collected on *P. repens*, a species on which *M. proteae* has not yet been recorded.

The asci and ascospores of the new species (Fig. 10) are considerably smaller ($32.0\text{--}57.2 \times 10.2\text{--}15.9\text{ }\mu\text{m}$ and $11.2\text{--}20.7 \times 3.9\text{--}7.6\text{ }\mu\text{m}$) than those (Fig. 11) of *M. proteae* ($52\text{--}100 \times 16\text{--}25\text{ }\mu\text{m}$ and $17\text{--}30 \times 5\text{--}9\text{ }\mu\text{m}$) as reported in the literature (Winter, 1884; Sydow & Sydow, 1914; Doidge, 1921; Petrak, 1924; Müller & Von Arx, 1962). Our own measurements of the asci and ascospores of *M. proteae* on *P. neriifolia* (PREM 44816) were $89.1\text{--}144.7 \times 11.4\text{--}23.6$ and $22.9\text{--}32.2 \times 5.3\text{--}10.1\text{ }\mu\text{m}$ respectively. The ascospores of *M. jonkershoekensis* are also not as unequally one-septate as those of *M. proteae*. The lower cell of the ellipsoidal ascospores is only very slightly longer and narrower than the upper cell (Fig. 10), while this difference is conspicuous in the oblong-cuneate ascospores of *M. proteae* (Fig. 11).

The combination of morphological features of *M. jonkershoekensis* i.e. circular, sunken, necrotic leaf spots, smaller asci and ascospores and ellipsoidal, almost medially one-septate ascospores, clearly differentiates it from *M. proteae*, the only other species of *Mycosphaerella* known to occur on the genus *Protea*, and it is accordingly described as a new species.

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